

SEQUENCE LISTING

<110> Hanke, Paul D.

Li-D'Elia, Lhing-Yew

Rayapati, John

Crafton, Corey

Walsh, Holly

<120> Polynucleotides Encoding A Feedback Resistant  
Aspartokinase From Corynebacterium

<130> 040049

<140> 09/722,441

<141> 2000-11-28

<150> US 60/173,707

<151> 1999-12-30

<150> US 60/184,130

<151> 2000-02-22

<160> 37

<170> PatentIn version 3.0

<210> 1

<211> 1266

<212> DNA

<213> *Corynebacterium glutamicum*

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Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala

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15

gaa cgc att aga aac gtc gct gaa cgg atc gtt gcc acc aag aag gct

96

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala

20

25

30

gga aat gat gtc gtg gtt gtc tgc tcc gca atg gga gac acc acg gat

144

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp

35

40

45

gaa ctt cta gaa ctt gca gcg gca gtg aat ccc gtt ccg cca gct cgt

192

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg

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60

gaa atg gat atg ctc ctg act gct ggt gag cgt att tct aac gct ctc

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Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu

65	70	75	80
gtc gcc atg gct att gag tcc ctt ggc gca gaa gct caa tct ttc act			
288			
Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr			
	85	90	95
ggc tct cag gct ggt gtg ctc acc acc gag cgc cac gga aac gca cgc			
336			
Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg			
	100	105	110
att gtt gac gtc aca ccg ggt cgt gtg cgt gaa gca ctc gat gag ggc			
384			
Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly			
	115	120	125
aag atc tgc att gtt gct ggt ttt cag ggt gtt aat aaa gaa acc cgc			
432			
Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg			
	130	135	140
gat gtc acc acg ttg ggt cgt ggt ggt tct gac acc act gca gtt gcg			
480			
Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala			
145	150	155	160
ttg gca gct gct ttg aac gct gat gtg tgt gag att tac tcg gac gtt			
528			
Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val			
	165	170	175
gac ggt gtg tat acc gct gac ccg cgc atc gtt cct aat gca cag aag			
576			
Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys			

180	185	190
ctg gaa aag ctc agc ttc gaa gaa atg ctg gaa ctt gct gct gtt ggc		
624		
Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly		
195	200	205
tcc aag att ttg gtg ctg cgc agt gtt gaa tac gct cgt gca ttc aat		
672		
Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn		
210	215	220
gtg cca ctt cgc gta cgc tcg tct tat agt aat gat ccc ggc act ttg		
720		
Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu		
225	230	235
att gcc ggc tct atg gag gat att cct gtg gaa gaa gca gtc ctt acc		
768		
Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr		
245	250	255
ggg gtc gca acc gac aag tcc gaa gcc aaa gta acc gtt ctg ggt att		
816		
Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile		
260	265	270
tcc gat aag cca ggc gag gct gcc aag gtt ttc cgt gcg ttg gct gat		
864		
Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp		
275	280	285
gca gaa atc aac att gac atg gtt ctg cag aac gtc tcc tct gtg gaa		
912		
Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu		

290

295

300

gac ggc acc acc gac atc acg ttc acc tgc cct cgc gct gac gga cgc

960

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg

305

310

315

320

cgt gcg atg gag atc ttg aag aag ctt cag gtt cag ggc aac tgg acc

1008

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr

325

330

335

aat gtg ctt tac gac gac cag gtc ggc aaa gtc tcc ctc gtg ggt gct

1056

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala

340

345

350

ggc atg aag tct cac cca ggt gtt acc gca gag ttc atg gaa gct ctg

1104

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu

355

360

365

cgc gat gtc aac gtg aac atc gaa ttg att tcc atc tct gag atc cgc

1152

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Ile Ser Glu Ile Arg

370

375

380

att tcc gtg ctg atc cgt gaa gat gat ctg gat gct gct gca cgt gca

1200

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala

385

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395

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1248

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr

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gca ggc acc gga cgc taa  
1266  
Ala Gly Thr Gly Arg

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<213> Corynebacterium glutamicum

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20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp  
35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg  
50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu  
65 70 75 80

Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr  
85 90 95

Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg

100

105

110

Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly  
 115 120 125

Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg  
 130 135 140

Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala  
 145 150 155 160

Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val  
 165 170 175

Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys  
 180 185 190

Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly  
 195 200 205

Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn  
 210 215 220

Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu  
 225 230 235 240

Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr  
 245 250 255

Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile  
 260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp  
 275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu  
 290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg  
305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr  
325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala  
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu  
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Ile Ser Glu Ile Arg  
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala  
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Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr  
405 410 415

Ala Gly Thr Gly Arg  
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<211> 1035

<212> DNA

<213> Corynebacterium glutamicum

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<221> CDS



<222> (1)..(1035)

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Met Thr Thr Ile Ala Val Val Gly Ala Thr Gly Gln Val Gly Gln Val

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atg cgc acc ttt ttg gaa gag cgc aat ttc cca gct gac act gtt cgt  
96

Met Arg Thr Phe Leu Glu Glu Arg Asn Phe Pro Ala Asp Thr Val Arg

20 25 30

ttc ttt gct tcc ccg cgt tcc gca ggc cgt aag att gaa ttc cgt ggc  
144

Phe Phe Ala Ser Pro Arg Ser Ala Gly Arg Lys Ile Glu Phe Arg Gly

35 40 45

acg gaa atc gag gta gaa gac att act cag gca acc gag gag tcc ctc  
192

Thr Glu Ile Glu Val Glu Asp Ile Thr Gln Ala Thr Glu Glu Ser Leu

50 55 60

aag ggc atc gac gtt gcg ttg ttc tct gct gga ggc acc gct tcc aag  
240

Lys Gly Ile Asp Val Ala Leu Phe Ser Ala Gly Gly Thr Ala Ser Lys

65 70 75 80

cag tac gct cca ctg ttt gct gct gca ggc gcg act gtt gtg gat aac  
288

Gln Tyr Ala Pro Leu Phe Ala Ala Ala Gly Ala Thr Val Val Asp Asn

85 90 95

tct tct gct tgg cgc aag gac gac gag gtt cca cta atc gtc tct gag

336  
Ser Ser Ala Trp Arg Lys Asp Asp Glu Val Pro Leu Ile Val Ser Glu

100

105

110

gtg aac cct tcc gac aag gat tcc ctg gtc aag ggc att att gcg aat  
384

Val Asn Pro Ser Asp Lys Asp Ser Leu Val Lys Gly Ile Ile Ala Asn

115

120

125

cct aac tgc acc acc atg gct gca atg cca gtg ctg aag cca ctg cac  
432

Pro Asn Cys Thr Thr Met Ala Ala Met Pro Val Leu Lys Pro Leu His

130

135

140

gat gcc gct ggt ctt gta aag ctt cac gtt tcc tct tac cag gct gtt  
480

Asp Ala Ala Gly Leu Val Lys Leu His Val Ser Ser Tyr Gln Ala Val

145

150

155

160

tcc ggt tct ggt ctt gca ggt gtg gaa acc ttg gca aag cag gtt gct  
528

Ser Gly Ser Gly Leu Ala Gly Val Glu Thr Leu Ala Lys Gln Val Ala

165

170

175

gca gtt ggc gac cac aac gtt gag ttc gtc cat gat gga cag gct gct  
576

Ala Val Gly Asp His Asn Val Glu Phe Val His Asp Gly Gln Ala Ala

180

185

190

gac gca ggc gat gtc gga cct tac gtt tcc cca atc gct tac aac gtg  
624

Asp Ala Gly Asp Val Gly Pro Tyr Val Ser Pro Ile Ala Tyr Asn Val

195

200

205

ctg cca ttc gcc gga aac ctc gtc gat gac ggc acc ttc gaa acc gac

672

Leu Pro Phe Ala Gly Asn Leu Val Asp Asp Gly Thr Phe Glu Thr Asp

210

215

220

gaa gag cag aag ctg cgc aac gaa tcc cgc aag att ctc ggc ctc cca  
720

Glu Glu Gln Lys Leu Arg Asn Glu Ser Arg Lys Ile Leu Gly Leu Pro

225

230

235

240

gac ctc aag gtc tca ggc acc tgc gtc cgc gtg ccg gtt ttc acc ggc  
768

Asp Leu Lys Val Ser Gly Thr Cys Val Arg Val Pro Val Phe Thr Gly

245

250

255

cac acg ctg acc att cac gcc gaa ttc gac aag gca atc acc gtc gag  
816

His Thr Leu Thr Ile His Ala Glu Phe Asp Lys Ala Ile Thr Val Glu

260

265

270

cag gcg cag gag atc ttg ggt gcc gct tca ggc gtc gag ctt gtc gac  
864

Gln Ala Gln Glu Ile Leu Gly Ala Ala Ser Gly Val Glu Leu Val Asp

275

280

285

gtc cca acc cca ctt gca gct gcc ggc att gac gaa tcc ctc gtt gga  
912

Val Pro Thr Pro Leu Ala Ala Ala Gly Ile Asp Glu Ser Leu Val Gly

290

295

300

cgc atc cgt cag gac tcc act gtc gac gac aac cgc ggt ctg gtt ctc  
960

Arg Ile Arg Gln Asp Ser Thr Val Asp Asp Asn Arg Gly Leu Val Leu

305

310

315

320

gtc gta tct ggc gat aac ctt cgc aag ggc gca gca ctg aac acc att  
1008

Val Val Ser Gly Asp Asn Leu Arg Lys Gly Ala Ala Leu Asn Thr Ile

325

330

335

cag att gct gag ctg ctg gtt aag taa

1035

Gln Ile Ala Glu Leu Leu Val Lys

340

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<213> Corynebacterium glutamicum

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20 25 30

Phe Phe Ala Ser Pro Arg Ser Ala Gly Arg Lys Ile Glu Phe Arg Gly  
35 40 45

Thr Glu Ile Glu Val Glu Asp Ile Thr Gln Ala Thr Glu Glu Ser Leu  
50 55 60

Lys Gly Ile Asp Val Ala Leu Phe Ser Ala Gly Gly Thr Ala Ser Lys  
65 70 75 80

Gln Tyr Ala Pro Leu Phe Ala Ala Ala Gly Ala Thr Val Val Asp Asn  
85 90 95

Ser Ser Ala Trp Arg Lys Asp Asp Glu Val Pro Leu Ile Val Ser Glu  
100 105 110

Val Asn Pro Ser Asp Lys Asp Ser Leu Val Lys Gly Ile Ile Ala Asn  
115 120 125

Pro Asn Cys Thr Thr Met Ala Ala Met Pro Val Leu Lys Pro Leu His  
130 135 140

Asp Ala Ala Gly Leu Val Lys Leu His Val Ser Ser Tyr Gln Ala Val  
145 150 155 160

Ser Gly Ser Gly Leu Ala Gly Val Glu Thr Leu Ala Lys Gln Val Ala  
165 170 175

Ala Val Gly Asp His Asn Val Glu Phe Val His Asp Gly Gln Ala Ala  
180 185 190

Asp Ala Gly Asp Val Gly Pro Tyr Val Ser Pro Ile Ala Tyr Asn Val  
195 200 205

Leu Pro Phe Ala Gly Asn Leu Val Asp Asp Gly Thr Phe Glu Thr Asp  
210 215 220

Glu Glu Gln Lys Leu Arg Asn Glu Ser Arg Lys Ile Leu Gly Leu Pro  
225 230 235 240

Asp Leu Lys Val Ser Gly Thr Cys Val Arg Val Pro Val Phe Thr Gly  
245 250 255

His Thr Leu Thr Ile His Ala Glu Phe Asp Lys Ala Ile Thr Val Glu  
260 265 270

Gln Ala Gln Glu Ile Leu Gly Ala Ala Ser Gly Val Glu Leu Val Asp  
275 280 285

Val Pro Thr Pro Leu Ala Ala Ala Gly Ile Asp Glu Ser Leu Val Gly  
 290 295 300

Arg Ile Arg Gln Asp Ser Thr Val Asp Asp Asn Arg Gly Leu Val Leu  
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Gln Ile Ala Glu Leu Leu Val Lys  
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<212> DNA

<213> Corynebacterium glutamicum

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gtt gga gta gca atg gtt act cca ttc acg gaa tcc gga gac atc gat  
 96

Val Gly Val Ala Met Val Thr Pro Phe Thr Glu Ser Gly Asp Ile Asp

20

25

30

atc gct gct ggc cgc gaa gtc gcg gct tat ttg gtt gat aag ggc ttg  
 144  
 Ile Ala Ala Gly Arg Glu Val Ala Ala Tyr Leu Val Asp Lys Gly Leu

35

40

45

gat tct ttg gtt ctc gcg ggc acc act ggt gaa tcc cca acg aca acc  
 192  
 Asp Ser Leu Val Leu Ala Gly Thr Thr Gly Glu Ser Pro Thr Thr Thr

50

55

60

gcc gct gaa aaa cta gaa ctg ctc aag gcc gtt cgt gag gaa gtt ggg  
 240  
 Ala Ala Glu Lys Leu Glu Leu Leu Lys Ala Val Arg Glu Glu Val Gly

65

70

75

80

gat cgg gcg aag ctc atc gcc ggt gtc gga acc aac aac acg cgg aca  
 288  
 Asp Arg Ala Lys Leu Ile Ala Gly Val Gly Thr Asn Asn Thr Arg Thr

85

90

95

tct gtg gaa ctt gcg gaa gct gct gct tct gct ggc gca gac ggc ctt  
 336  
 Ser Val Glu Leu Ala Glu Ala Ala Ala Ser Ala Gly Ala Asp Gly Leu

100

105

110

tta gtt gta act cct tat tac tcc aag ccg agc caa gag gga ttg ctg  
 384  
 Leu Val Val Thr Pro Tyr Tyr Ser Lys Pro Ser Gln Glu Gly Leu Leu

115

120

125

gcg cac ttc ggt gca att gct gca gca aca gag gtt cca att tgt ctc  
 432  
 Ala His Phe Gly Ala Ile Ala Ala Ala Thr Glu Val Pro Ile Cys Leu

130	135	140
tat gac att cct ggt cgg tca ggt att cca att gaa tct gat acc atg 480		
Tyr Asp Ile Pro Gly Arg Ser Gly Ile Pro Ile Glu Ser Asp Thr Met		
145	150	155
		160
aga cgc ctg agt gaa tta cct acg att ttg gcg gtc aag gac gcc aag 528		
Arg Arg Leu Ser Glu Leu Pro Thr Ile Leu Ala Val Lys Asp Ala Lys		
	165	170
		175
ggt gac ctc gtt gca gcc acg tca ttg atc aaa gaa acg gga ctt gcc 576		
Gly Asp Leu Val Ala Ala Thr Ser Leu Ile Lys Glu Thr Gly Leu Ala		
	180	185
		190
tgg tat tca ggc gat gac cca cta aac ctt gtt tgg ctt gct ttg ggc 624		
Trp Tyr Ser Gly Asp Asp Pro Leu Asn Leu Val Trp Leu Ala Leu Gly		
	195	200
		205
gga tca ggt ttc att tcc gta att gga cat gca gcc ccc aca gca tta 672		
Gly Ser Gly Phe Ile Ser Val Ile Gly His Ala Ala Pro Thr Ala Leu		
	210	215
		220
cgt gag ttg tac aca agc ttc gag gaa ggc gac ctc gtc cgt gcg cgg 720		
Arg Glu Leu Tyr Thr Ser Phe Glu Glu Gly Asp Leu Val Arg Ala Arg		
225	230	235
		240
gaa atc aac gcc aaa cta tca ccg ctg gta gct gcc caa ggt cgc ttg 768		
Glu Ile Asn Ala Lys Leu Ser Pro Leu Val Ala Ala Gln Gly Arg Leu		



245	250	255
ggt gga gtc agc ttg gca aaa gct gct ctg cgt ctg cag ggc atc aac 816 Gly Gly Val Ser Leu Ala Lys Ala Ala Leu Arg Leu Gln Gly Ile Asn		
260	265	270
gta gga gat cct cga ctt cca att atg gct cca aat gag cag gaa ctt 864 Val Gly Asp Pro Arg Leu Pro Ile Met Ala Pro Asn Glu Gln Glu Leu		
275	280	285
gag gct ctc cga gaa gac atg aaa aaa gct gga gtt cta taa 906 Glu Ala Leu Arg Glu Asp Met Lys Lys Ala Gly Val Leu		
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<212> PRT

<213> Corynebacterium glutamicum

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			20					25					30		
Ile	Ala	Ala	Gly	Arg	Glu	Val	Ala	Ala	Tyr	Leu	Val	Asp	Lys	Gly	Leu
	35						40					45			

Asp	Ser	Leu	Val	Leu	Ala	Gly	Thr	Thr	Gly	Glu	Ser	Pro	Thr	Thr	Thr		
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Ala	Ala	Glu	Lys	Leu	Glu	Leu	Leu	Lys	Ala	Val	Arg	Glu	Glu	Val	Gly		
65					70					75					80		
Asp	Arg	Ala	Lys	Leu	Ile	Ala	Gly	Val	Gly	Thr	Asn	Asn	Thr	Arg	Thr		
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Ser	Val	Glu	Leu	Ala	Glu	Ala	Ala	Ala	Ser	Ala	Gly	Ala	Asp	Gly	Leu		
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Leu	Val	Val	Thr	Pro	Tyr	Tyr	Ser	Lys	Pro	Ser	Gln	Glu	Gly	Leu	Leu		
		115					120					125					
Ala	His	Phe	Gly	Ala	Ile	Ala	Ala	Ala	Thr	Glu	Val	Pro	Ile	Cys	Leu		
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Tyr	Asp	Ile	Pro	Gly	Arg	Ser	Gly	Ile	Pro	Ile	Glu	Ser	Asp	Thr	Met		
145					150					155					160		
Arg	Arg	Leu	Ser	Glu	Leu	Pro	Thr	Ile	Leu	Ala	Val	Lys	Asp	Ala	Lys		
				165					170					175			
Gly	Asp	Leu	Val	Ala	Ala	Thr	Ser	Leu	Ile	Lys	Glu	Thr	Gly	Leu	Ala		
		180						185					190				
Trp	Tyr	Ser	Gly	Asp	Asp	Pro	Leu	Asn	Leu	Val	Trp	Leu	Ala	Leu	Gly		
		195					200					205					
Gly	Ser	Gly	Phe	Ile	Ser	Val	Ile	Gly	His	Ala	Ala	Pro	Thr	Ala	Leu		
	210					215					220						
Arg	Glu	Leu	Tyr	Thr	Ser	Phe	Glu	Glu	Gly	Asp	Leu	Val	Arg	Ala	Arg		
225					230					235					240		

Glu Ile Asn Ala Lys Leu Ser Pro Leu Val Ala Ala Gln Gly Arg Leu  
 245 250 255

Gly Gly Val Ser Leu Ala Lys Ala Ala Leu Arg Leu Gln Gly Ile Asn  
 260 265 270

Val Gly Asp Pro Arg Leu Pro Ile Met Ala Pro Asn Glu Gln Glu Leu  
 275 280 285

Glu Ala Leu Arg Glu Asp Met Lys Lys Ala Gly Val Leu  
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<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (1)..(747)

<400> 7

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Met Gly Ile Lys Val Gly Val Leu Gly Ala Lys Gly Arg Val Gly Gln

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act att gtg gca gca gtc aat gag tcc gac gat ctg gag ctt gtt gca  
 96

Thr Ile Val Ala Ala Val Asn Glu Ser Asp Asp Leu Glu Leu Val Ala

20 25 30

gag atc ggc gtc gac gat gat ttg agc ctt ctg gta gac aac ggc gct  
144

Glu Ile Gly Val Asp Asp Asp Leu Ser Leu Leu Val Asp Asn Gly Ala

35

40

45

gaa gtt gtc gtt gac ttc acc act cct aac gct gtg atg ggc aac ctg  
192

Glu Val Val Val Asp Phe Thr Thr Pro Asn Ala Val Met Gly Asn Leu

50

55

60

gag ttc tgc atc aac aac ggc att tct gcg gtt gtt gga acc acg ggc  
240

Glu Phe Cys Ile Asn Asn Gly Ile Ser Ala Val Val Gly Thr Thr Gly

65

70

75

80

ttc gat aat gct cgt ttg gag cag gtt cgc gcc tgg ctt gaa gga aaa  
288

Phe Asp Asn Ala Arg Leu Glu Gln Val Arg Ala Trp Leu Glu Gly Lys

85

90

95

gac aat gtc ggt gtt ctg atc gca cct aac ttt gct atc tct gcg gtg  
336

Asp Asn Val Gly Val Leu Ile Ala Pro Asn Phe Ala Ile Ser Ala Val

100

105

110

ttg acc atg gtc ttt tcc aag cag gct gcc cgc ttc ttc gaa tca gct  
384

Leu Thr Met Val Phe Ser Lys Gln Ala Ala Arg Phe Phe Glu Ser Ala

115

120

125

gaa gtt att gag ctg cac cac ccc aac aag ctg gat gca cct tca ggc  
432

Glu Val Ile Glu Leu His His Pro Asn Lys Leu Asp Ala Pro Ser Gly

130

135

140

acc gcg atc cac act gct cag ggc att gct gcg gca cgc aaa gaa gca  
480

Thr Ala Ile His Thr Ala Gln Gly Ile Ala Ala Ala Arg Lys Glu Ala

145

150

155

160

ggc atg gac gca cag cca gat gcg acc gag cag gca ctt gag ggt tcc  
528

Gly Met Asp Ala Gln Pro Asp Ala Thr Glu Gln Ala Leu Glu Gly Ser

165

170

175

cgt ggc gca agc gta gat gga atc cca gtt cac gca gtc cgc atg tcc  
576

Arg Gly Ala Ser Val Asp Gly Ile Pro Val His Ala Val Arg Met Ser

180

185

190

ggc atg gtt gct cac gag caa gtt atc ttt ggc acc cag ggt cag acc  
624

Gly Met Val Ala His Glu Gln Val Ile Phe Gly Thr Gln Gly Gln Thr

195

200

205

ttg acc atc aag cag gac tcc tat gat cgc aac tca ttt gca cca ggt  
672

Leu Thr Ile Lys Gln Asp Ser Tyr Asp Arg Asn Ser Phe Ala Pro Gly

210

215

220

gtc ttg gtg ggt gtg cgc aac att gca cag cac cca ggc cta gtc gta  
720

Val Leu Val Gly Val Arg Asn Ile Ala Gln His Pro Gly Leu Val Val

225

230

235

240

gga ctt gag cat tac cta ggc ctg taa  
747

Gly Leu Glu His Tyr Leu Gly Leu

245

<210> 8

<211> 248

<212> PRT

<213> Corynebacterium glutamicum

<400> 8

Met Gly Ile Lys Val Gly Val Leu Gly Ala Lys Gly Arg Val Gly Gln  
1 5 10 15

Thr Ile Val Ala Ala Val Asn Glu Ser Asp Asp Leu Glu Leu Val Ala  
20 25 30

Glu Ile Gly Val Asp Asp Asp Leu Ser Leu Leu Val Asp Asn Gly Ala  
35 40 45

Glu Val Val Val Asp Phe Thr Thr Pro Asn Ala Val Met Gly Asn Leu  
50 55 60

Glu Phe Cys Ile Asn Asn Gly Ile Ser Ala Val Val Gly Thr Thr Gly  
65 70 75 80

Phe Asp Asn Ala Arg Leu Glu Gln Val Arg Ala Trp Leu Glu Gly Lys  
85 90 95

Asp Asn Val Gly Val Leu Ile Ala Pro Asn Phe Ala Ile Ser Ala Val  
100 105 110

Leu Thr Met Val Phe Ser Lys Gln Ala Ala Arg Phe Phe Glu Ser Ala  
115 120 125

Glu Val Ile Glu Leu His His Pro Asn Lys Leu Asp Ala Pro Ser Gly  
130 135 140

Thr Ala Ile His Thr Ala Gln Gly Ile Ala Ala Ala Arg Lys Glu Ala  
 145 150 155 160

Gly Met Asp Ala Gln Pro Asp Ala Thr Glu Gln Ala Leu Glu Gly Ser  
 165 170 175

Arg Gly Ala Ser Val Asp Gly Ile Pro Val His Ala Val Arg Met Ser  
 180 185 190

Gly Met Val Ala His Glu Gln Val Ile Phe Gly Thr Gln Gly Gln Thr  
 195 200 205

Leu Thr Ile Lys Gln Asp Ser Tyr Asp Arg Asn Ser Phe Ala Pro Gly  
 210 215 220

Val Leu Val Gly Val Arg Asn Ile Ala Gln His Pro Gly Leu Val Val  
 225 230 235 240

Gly Leu Glu His Tyr Leu Gly Leu  
 245

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<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (1) .. (1023)

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48
Met His Phe Gly Lys Leu Asp Gln Asp Ser Ala Thr Thr Ile Leu Glu

1          5          10          15

gat tac aag aac atg acc aac atc cgc gta gct atc gta ggc tac gga
96
Asp Tyr Lys Asn Met Thr Asn Ile Arg Val Ala Ile Val Gly Tyr Gly

          20          25          30

aac ctg gga cgc agc gtc gaa aag ctt att gcc aag cag ccc gac atg
144
Asn Leu Gly Arg Ser Val Glu Lys Leu Ile Ala Lys Gln Pro Asp Met

          35          40          45

gac ctt gta gga atc ttc tcg cgc cgg gcc acc ctc gac aca aag acg
192
Asp Leu Val Gly Ile Phe Ser Arg Arg Ala Thr Leu Asp Thr Lys Thr

          50          55          60

cca gtc ttt gat gtc gcc gac gtg gac aag cac gcc gac gac gtg gac
240
Pro Val Phe Asp Val Ala Asp Val Asp Lys His Ala Asp Asp Val Asp

65          70          75          80

gtg ctg ttc ctg tgc atg ggc tcc gcc acc gac atc cct gag cag gca
288

Val Leu Phe Leu Cys Met Gly Ser Ala Thr Asp Ile Pro Glu Gln Ala

          85          90          95

cca aag ttc gcg cag ttc gcc tgc acc gta gac acc tac gac aac cac
336
Pro Lys Phe Ala Gln Phe Ala Cys Thr Val Asp Thr Tyr Asp Asn His

          100          105          110

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cgc gac atc cca cgc cac cgc cag gtc atg aac gaa gcc gcc acc gca  
384

Arg Asp Ile Pro Arg His Arg Gln Val Met Asn Glu Ala Ala Thr Ala

115

120

125

gcc ggc aac gtt gca ctg gtc tct acc ggc tgg gat cca gga atg ttc  
432

Ala Gly Asn Val Ala Leu Val Ser Thr Gly Trp Asp Pro Gly Met Phe

130

135

140

tcc atc aac cgc gtc tac gca gcg gca gtc tta gcc gag cac cag cag  
480

Ser Ile Asn Arg Val Tyr Ala Ala Ala Val Leu Ala Glu His Gln Gln

145

150

155

160

cac acc ttc tgg ggc cca ggt ttg tca cag ggc cac tcc gat gct ttg  
528

His Thr Phe Trp Gly Pro Gly Leu Ser Gln Gly His Ser Asp Ala Leu

165

170

175

cga cgc atc cct ggc gtt caa aag gcc gtc cag tac acc ctc cca tcc  
576

Arg Arg Ile Pro Gly Val Gln Lys Ala Val Gln Tyr Thr Leu Pro Ser

180

185

190

gaa gaa gcc ctg gaa aag gcc cgc cgt ggc gaa gcc ggc gac ctc acc  
624

Glu Glu Ala Leu Glu Lys Ala Arg Arg Gly Glu Ala Gly Asp Leu Thr

195

200

205

gga aag caa acc cac aag cgc caa tgc ttc gtg gtt gcc gac gcg gcc  
672

Gly Lys Gln Thr His Lys Arg Gln Cys Phe Val Val Ala Asp Ala Ala

210

215

220

gac cac gag cgc atc gaa aac gac atc cgc acc atg cct gat tac ttc  
720

Asp His Glu Arg Ile Glu Asn Asp Ile Arg Thr Met Pro Asp Tyr Phe

225

230

235

240

gtt ggc tac gaa gtc gaa gtc aac ttc atc gac gaa gca acc ttg gac  
768

Val Gly Tyr Glu Val Glu Val Asn Phe Ile Asp Glu Ala Thr Leu Asp

245

250

255

gcc gag cac acc ggc atg cca cac ggc gga cac gtg atc acc acc ggc  
816

Ala Glu His Thr Gly Met Pro His Gly Gly His Val Ile Thr Thr Gly

260

265

270

gac acc ggt ggc ttc aac cac acc gtg gaa tac atc ctg aag ctg gac  
864

Asp Thr Gly Gly Phe Asn His Thr Val Glu Tyr Ile Leu Lys Leu Asp

275

280

285

cga aac cca gat ttc acc gct tct tca cag atc gct ttc ggc cgc gca  
912

Arg Asn Pro Asp Phe Thr Ala Ser Ser Gln Ile Ala Phe Gly Arg Ala

290

295

300

gct cac cgc atg aag cag cag ggc caa agc ggt gct ttc acc gtc ctc  
960

Ala His Arg Met Lys Gln Gln Gly Gln Ser Gly Ala Phe Thr Val Leu

305

310

315

320

gaa gtt gct cca tac ttg ctc tcc ccg gag aac ttg gat gat ctg atc  
1008

Glu Val Ala Pro Tyr Leu Leu Ser Pro Glu Asn Leu Asp Asp Leu Ile

325

330

335

gca cgc gac gtc taa  
1023  
Ala Arg Asp Val

340

<210> 10

<211> 340

<212> PRT

<213> Corynebacterium glutamicum

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Met His Phe Gly Lys Leu Asp Gln Asp Ser Ala Thr Thr Ile Leu Glu  
1 5 10 15

Asp Tyr Lys Asn Met Thr Asn Ile Arg Val Ala Ile Val Gly Tyr Gly  
20 25 30

Asn Leu Gly Arg Ser Val Glu Lys Leu Ile Ala Lys Gln Pro Asp Met  
35 40 45

Asp Leu Val Gly Ile Phe Ser Arg Arg Ala Thr Leu Asp Thr Lys Thr  
50 55 60

Pro Val Phe Asp Val Ala Asp Val Asp Lys His Ala Asp Asp Val Asp  
65 70 75 80

Val Leu Phe Leu Cys Met Gly Ser Ala Thr Asp Ile Pro Glu Gln Ala  
85 90 95

Pro Lys Phe Ala Gln Phe Ala Cys Thr Val Asp Thr Tyr Asp Asn His  
100 105 110

Arg Asp Ile Pro Arg His Arg Gln Val Met Asn Glu Ala Ala Thr Ala  
 115 120 125

Ala Gly Asn Val Ala Leu Val Ser Thr Gly Trp Asp Pro Gly Met Phe  
 130 135 140

Ser Ile Asn Arg Val Tyr Ala Ala Ala Val Leu Ala Glu His Gln Gln  
 145 150 155 160

His Thr Phe Trp Gly Pro Gly Leu Ser Gln Gly His Ser Asp Ala Leu  
 165 170 175

Arg Arg Ile Pro Gly Val Gln Lys Ala Val Gln Tyr Thr Leu Pro Ser  
 180 185 190

Glu Glu Ala Leu Glu Lys Ala Arg Arg Gly Glu Ala Gly Asp Leu Thr  
 195 200 205

Gly Lys Gln Thr His Lys Arg Gln Cys Phe Val Val Ala Asp Ala Ala  
 210 215 220

Asp His Glu Arg Ile Glu Asn Asp Ile Arg Thr Met Pro Asp Tyr Phe  
 225 230 235 240

Val Gly Tyr Glu Val Glu Val Asn Phe Ile Asp Glu Ala Thr Leu Asp  
 245 250 255

Ala Glu His Thr Gly Met Pro His Gly Gly His Val Ile Thr Thr Gly  
 260 265 270

Asp Thr Gly Gly Phe Asn His Thr Val Glu Tyr Ile Leu Lys Leu Asp  
 275 280 285

Arg Asn Pro Asp Phe Thr Ala Ser Ser Gln Ile Ala Phe Gly Arg Ala  
 290 295 300

Ala His Arg Met Lys Gln Gln Gly Gln Ser Gly Ala Phe Thr Val Leu  
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Glu Val Ala Pro Tyr Leu Leu Ser Pro Glu Asn Leu Asp Asp Leu Ile  
 325 330 335

Ala Arg Asp Val  
 340

<210> 11

<211> 1338

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1) .. (1338)

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 48

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro

1 5 10 15

cgc aat gca gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg  
 96

Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val

20 25 30

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc

144

Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val

35

40

45

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc  
192

Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe

50

55

60

ggt gga cca ggc aat gtg cac tac gca tcc aaa gcg ttc ctg acc aag  
240

Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys

65

70

75

80

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gcg  
288

Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala

85

90

95

tcc atc aat gaa ctg ggc att gcc ctg gcc gct ggt ttc ccg gcc agc  
336

Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser

100

105

110

cgt atc acc gcg cac ggc aac aac aaa ggc gta gag ttc ctg cgc gcg  
384

Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala

115

120

125

ttg gtt caa aac ggt gtc ggg cat gtg gtg ctg gac tcc gcg cag gaa  
432

Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu

130

135

140

ttg gaa ctg ctg gat tac gtt gcc gct ggt gaa ggc aag atc cag gac

480  
Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp

145 150 155 160

gtg ttg atc cgc gtg aag cca ggt atc gaa gcc cac acc cac gag ttc  
528

Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe

165 170 175

atc gcc act agc cac gaa gac cag aag ttc gga ttc tcc ctg gca tcc  
576

Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser

180 185 190

ggt tcc gca ttc gaa gca gcg aaa gca gcc aac aat gca gag aac ttg  
624

Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu

195 200 205

aac ctg gtt ggt ctg cac tgc cat gtt ggt tcc cag gtg ttc gac gcc  
672

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala

210 215 220

gaa ggc ttc aag ctg gca gca gag cgc gtg ttg ggc ctg tac tca cag  
720

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln

225 230 235 240

atc cac agc gaa cta ggt gtc gcc ctt cct gag ctg gac ctc ggt ggc  
768

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly

245 250 255

gga tac ggc atc gcc tac act gca gat gag gaa cca ctc aac gtc gca

816

Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala

260

265

270

gaa gtc gcc tcc gac cta ctc acc gca gtc gga aaa atg gca gcg gaa  
864

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu

275

280

285

cta ggc atc gac gca cca acc gtg ctt gtt gag ccc ggc cgc gct atc  
912

Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile

290

295

300

gca ggc ccc tcc acc gtg acc atc tac gaa gtc ggc acc acc aaa aac  
960

Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asn

305

310

315

320

gtc cac gta gac gac gac aaa acc cgc cgc tac gta gcc gtc gac gga  
1008

Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Val Ala Val Asp Gly

325

330

335

ggc atg tcc gac aac atc cgc cca gca ctc tac ggc tcc gaa tac gac  
1056

Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp

340

345

350

gcc cgc gta gta tcc cgc ttc gcc gaa gga gac cca gta agc acc cgc  
1104

Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg

355

360

365

atc gtg ggc tcc cac tgc gaa tcc ggc gat atc ctg atc aac gat gaa



1152  
Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu

370

375

380

atc tac cca tct gac atc acc agc ggc gac ttc ctc gca ctc gca gcc  
1200

Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala

385

390

395

400

acc ggc gca tac tgc tac gcc atg agc tcc cgc tac aac gcc ttc aca  
1248

Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr

405

410

415

cgg ccc gcc gtc gtg tcc gtc cgc gct ggc agc tcc cgc ctc atg ctg  
1296

Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu

420

425

430

cgc cgc gaa acc ctc gac gac atc ctc tca cta gag gca taa  
1338

Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala

435

440

445

<210> 12

<211> 445

<212> PRT

<213> Corynebacterium glutamicum

<400> 12

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro

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			20					25					30				
Pro	Leu	Pro	Asp	Leu	Ala	Glu	Glu	Tyr	Gly	Thr	Pro	Leu	Phe	Val	Val		
		35					40					45					
Asp	Glu	Asp	Asp	Phe	Arg	Ser	Arg	Cys	Arg	Asp	Met	Ala	Thr	Ala	Phe		
	50					55					60						
Gly	Gly	Pro	Gly	Asn	Val	His	Tyr	Ala	Ser	Lys	Ala	Phe	Leu	Thr	Lys		
65					70					75					80		
Thr	Ile	Ala	Arg	Trp	Val	Asp	Glu	Glu	Gly	Leu	Ala	Leu	Asp	Ile	Ala		
				85					90					95			
Ser	Ile	Asn	Glu	Leu	Gly	Ile	Ala	Leu	Ala	Ala	Gly	Phe	Pro	Ala	Ser		
			100					105					110				
Arg	Ile	Thr	Ala	His	Gly	Asn	Asn	Lys	Gly	Val	Glu	Phe	Leu	Arg	Ala		
		115					120					125					
Leu	Val	Gln	Asn	Gly	Val	Gly	His	Val	Val	Leu	Asp	Ser	Ala	Gln	Glu		
	130					135					140						
Leu	Glu	Leu	Leu	Asp	Tyr	Val	Ala	Ala	Gly	Glu	Gly	Lys	Ile	Gln	Asp		
145					150					155					160		
Val	Leu	Ile	Arg	Val	Lys	Pro	Gly	Ile	Glu	Ala	His	Thr	His	Glu	Phe		
				165					170					175			
Ile	Ala	Thr	Ser	His	Glu	Asp	Gln	Lys	Phe	Gly	Phe	Ser	Leu	Ala	Ser		
			180					185					190				
Gly	Ser	Ala	Phe	Glu	Ala	Ala	Lys	Ala	Ala	Asn	Asn	Ala	Glu	Asn	Leu		
		195					200					205					

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala  
 210 215 220

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln  
 225 230 235 240

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly  
 245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala  
 260 265 270

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu  
 275 280 285

Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile  
 290 295 300

Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asn  
 305 310 315 320

Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Val Ala Val Asp Gly  
 325 330 335

Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp  
 340 345 350

Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg  
 355 360 365

Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu  
 370 375 380

Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala  
 385 390 395 400

Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr  
405 410 415

Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu  
420 425 430

Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala  
435 440 445

<210> 13

<211> 1338

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(1338)

<400> 13

atg gct aca gtt gaa aat ttc aat gaa ctt ccc gca cac gta tgg cca  
48

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro

1 5 10 15

cgc aat gcc gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg  
96

Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val

20 25 30

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc  
144

Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val

35

40

45

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc  
192

Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe

50

55

60

ggt gga cca ggc aat gtg cac tac gca tct aaa gcg ttc ctg acc aag  
240

Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys

65

70

75

80

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gca  
288

Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala

85

90

95

tcc atc aac gaa ctg ggc att gcc ctg gcc gct ggt ttc ccc gcc agc  
336

Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser

100

105

110

cgt atc acc gcg cac ggc aac aac aaa ggc gta gag ttc ctg cgc gcg  
384

Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala

115

120

125

ttg gtt caa aac ggt gtg gga cac gtg gtg ctg gac tcc gca cag gaa  
432

Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu

130

135

140

cta gaa ctg ttg gat tac gtt gcc gct ggt gaa ggc aag att cag gac  
480

Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp  
 145 150 155 160

gtg ttg atc cgc gta aag cca ggc atc gaa gca cac acc cac gag ttc  
 528  
 Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe  
 165 170 175

atc gcc act agc cac gaa gac cag aag ttc gga ttc tcc ctg gca tcc  
 576  
 Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser  
 180 185 190

ggt tcc gca ttc gaa gca gca aaa gcc gcc aac aac gca gaa aac ctg  
 624  
 Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu  
 195 200 205

aac ctg gtt ggc ctg cac tgc cac gtt ggt tcc cag gtg ttc gac gcc  
 672  
 Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala  
 210 215 220

gaa ggc ttc aag ctg gca gca gaa cgc gtg ttg ggc ctg tac tca cag  
 720  
 Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln  
 225 230 235 240

atc cac agc gaa ctg ggc gtt gcc ctt cct gaa ctg gat ctc ggt ggc  
 768  
 Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly  
 245 250 255

gga tac ggc att gcc tat acc gca gct gaa gaa cca ctc aac gtc gca

816

Gly Tyr Gly Ile Ala Tyr Thr Ala Ala Glu Glu Pro Leu Asn Val Ala

260

265

270

gaa gtt gcc tcc gac ctg ctc acc gca gtc gga aaa atg gca gcg gaa

864

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu

275

280

285

cta ggc atc gac gca cca acc gtg ctt gtt gag ccc ggc cgc gct atc

912

Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile

290

295

300

gca ggc ccc tcc acc gtg acc atc tac gaa gtc ggc acc acc aaa gac

960

Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp

305

310

315

320

gtc cac gta gac gac gac aaa acc cgc cgt tac atc gcc gtg gac gga

1008

Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly

325

330

335

ggc atg tcc gac aac atc cgc cca gca ctc tac ggc tcc gaa tac gac

1056

Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp

340

345

350

gcc cgc gta gta tcc cgc ttc gcc gaa gga gac cca gta agc acc cgc

1104

Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg

355

360

365

atc gtg ggc tcc cac tgc gaa tcc ggc gat atc ctg atc aac gat gaa

1152

Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu

370

375

380

atc tac cca tct gac atc acc agc ggc gac ttc ctt gca ctc gca gcc  
1200

Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala

385

390

395

400

acc ggc gca tac tgc tac gcc atg agc tcc cgc tac aac gcc ttc aca  
1248

Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr

405

410

415

cgg ccc gcc gtc gtg tcc gtc cgc gct ggc agc tcc cgc ctc atg ctg  
1296

Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu

420

425

430

cgc cgc gaa acg ctc gac gac atc ctc tca cta gag gca taa  
1338

Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala

435

440

445

<210> 14

<211> 445

<212> PRT

<213> Corynebacterium glutamicum

<400> 14

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro



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Arg	Asn	Ala	Val	Arg	Gln	Glu	Asp	Gly	Val	Val	Thr	Val	Ala	Gly	Val	
		20						25					30			
Pro	Leu	Pro	Asp	Leu	Ala	Glu	Glu	Tyr	Gly	Thr	Pro	Leu	Phe	Val	Val	
		35					40					45				
Asp	Glu	Asp	Asp	Phe	Arg	Ser	Arg	Cys	Arg	Asp	Met	Ala	Thr	Ala	Phe	
	50					55					60					
Gly	Gly	Pro	Gly	Asn	Val	His	Tyr	Ala	Ser	Lys	Ala	Phe	Leu	Thr	Lys	
65					70					75					80	
Thr	Ile	Ala	Arg	Trp	Val	Asp	Glu	Glu	Gly	Leu	Ala	Leu	Asp	Ile	Ala	
				85					90					95		
Ser	Ile	Asn	Glu	Leu	Gly	Ile	Ala	Leu	Ala	Ala	Gly	Phe	Pro	Ala	Ser	
			100					105					110			
Arg	Ile	Thr	Ala	His	Gly	Asn	Asn	Lys	Gly	Val	Glu	Phe	Leu	Arg	Ala	
		115					120					125				
Leu	Val	Gln	Asn	Gly	Val	Gly	His	Val	Val	Leu	Asp	Ser	Ala	Gln	Glu	
	130					135					140					
Leu	Glu	Leu	Leu	Asp	Tyr	Val	Ala	Ala	Gly	Glu	Gly	Lys	Ile	Gln	Asp	
145					150					155					160	
Val	Leu	Ile	Arg	Val	Lys	Pro	Gly	Ile	Glu	Ala	His	Thr	His	Glu	Phe	
				165					170					175		
Ile	Ala	Thr	Ser	His	Glu	Asp	Gln	Lys	Phe	Gly	Phe	Ser	Leu	Ala	Ser	
			180					185					190			
Gly	Ser	Ala	Phe	Glu	Ala	Ala	Lys	Ala	Ala	Asn	Asn	Ala	Glu	Asn	Leu	
		195					200					205				

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala  
 210 215 220

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln  
 225 230 235 240

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly  
 245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Ala Glu Glu Pro Leu Asn Val Ala  
 260 265 270

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu  
 275 280 285

Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile  
 290 295 300

Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp  
 305 310 315 320

Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly  
 325 330 335

Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp  
 340 345 350

Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg  
 355 360 365

Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu  
 370 375 380

Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala  
 385 390 395 400

Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr  
405 410 415

Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu  
420 425 430

Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala  
435 440 445

<210> 15

<211> 753

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(753)

<400> 15

gtg gcc gaa caa gtt aaa ttg agc gtg gag ttg ata gcg tgc agt tct  
48

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser

1 5 10 15

ttt act cca ccc gct gat gtt gag tgg tca act gat gtt gag ggc gcg  
96

Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala

20 25 30

gaa gca ctc gtc gag ttt gcg ggt cgt gcc tgc tac gaa act ttt gat

43

144

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp

35

40

45

aag ccg aac cct cga act gct tcc aat gct gcg tat ctg cgc cac atc  
192

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile

50

55

60

atg gaa gtg ggg cac act gct ttg ctt gag cat gcc aat gcc acg atg  
240

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met

65

70

75

80

tat atc cga ggc att tct cgg tcc gcg acc cat gaa ttg gtc cga cac  
288

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His

85

90

95

cgc cat ttt tcc ttc tct caa ctg tct cag cgt ttc gtg cac agc gga  
336

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly

100

105

110

gaa tcg gaa gta gtg gtg ccc act ctc atc gat gaa gat ccg cag ttg  
384

Glu Ser Glu Val Val Val Pro Thr Leu Ile Asp Glu Asp Pro Gln Leu

115

120

125

cgf gaa ctt ttc atg cac gcc atg gat gag tct cgg ttc gct ttc aat  
432

Arg Glu Leu Phe Met His Ala Met Asp Glu Ser Arg Phe Ala Phe Asn

130

135

140

gag ctg ctt aat gcg ctg gaa gaa aaa ctt ggc gat gaa ccg aat gca

480  
Glu Leu Leu Asn Ala Leu Glu Glu Lys Leu Gly Asp Glu Pro Asn Ala

145 150 155 160

ctt tta agg aaa aag cag gct cgt caa gca gct cgc gct gtg ctg ccc  
528

Leu Leu Arg Lys Lys Gln Ala Arg Gln Ala Ala Arg Ala Val Leu Pro

165 170 175

aac gct aca gag tcc aga atc gtg gtg tct gga aac ttc cgc acc tgg  
576

Asn Ala Thr Glu Ser Arg Ile Val Val Ser Gly Asn Phe Arg Thr Trp

180 185 190

agg cat ttc att ggc atg cga gcc agt gaa cat gca gac gtc gaa atc  
624

Arg His Phe Ile Gly Met Arg Ala Ser Glu His Ala Asp Val Glu Ile

195 200 205

cgc gaa gta gcg gta gga tgt tta aga aag ctg cag gta gca gcg cca  
672

Arg Glu Val Ala Val Gly Cys Leu Arg Lys Leu Gln Val Ala Ala Pro

210 215 220

act gtt ttc ggt gat ttt gag att gaa act ttg gca gac gga tcg caa  
720

Thr Val Phe Gly Asp Phe Glu Ile Glu Thr Leu Ala Asp Gly Ser Gln

225 230 235 240

atg gca aca agc ccg tat gtc atg gac ttt taa  
753

Met Ala Thr Ser Pro Tyr Val Met Asp Phe

245 250

<210> 16

<211> 250

<212> PRT

<213> Corynebacterium glutamicum

<400> 16

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser  
1 5 10 15

Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala  
20 25 30

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp  
35 40 45

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile  
50 55 60

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met  
65 70 75 80

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His  
85 90 95

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly  
100 105 110

Glu Ser Glu Val Val Val Pro Thr Leu Ile Asp Glu Asp Pro Gln Leu  
115 120 125

Arg Glu Leu Phe Met His Ala Met Asp Glu Ser Arg Phe Ala Phe Asn  
130 135 140

Glu Leu Leu Asn Ala Leu Glu Glu Lys Leu Gly Asp Glu Pro Asn Ala  
 145 150 155 160

Leu Leu Arg Lys Lys Gln Ala Arg Gln Ala Ala Arg Ala Val Leu Pro  
 165 170 175

Asn Ala Thr Glu Ser Arg Ile Val Val Ser Gly Asn Phe Arg Thr Trp  
 180 185 190

Arg His Phe Ile Gly Met Arg Ala Ser Glu His Ala Asp Val Glu Ile  
 195 200 205

Arg Glu Val Ala Val Gly Cys Leu Arg Lys Leu Gln Val Ala Ala Pro  
 210 215 220

Thr Val Phe Gly Asp Phe Glu Ile Glu Thr Leu Ala Asp Gly Ser Gln  
 225 230 235 240

Met Ala Thr Ser Pro Tyr Val Met Asp Phe  
 245 250

<210> 17

<211> 551

<212> DNA

<213> *Corynebacterium glutamicum*

<400> 17

aaccggtgtg gagccgacca ttccgcgagg ctgcactgca acgaggctcg agttttggta  
 60

catggcttct ggccagttca tggattggct gccgaagaag ctataggcat cgccaccagg  
 120

gccaccggag ttaccgaaga tgggtgccgtg cttttcgct tgggcaggga ccttgacaaa  
 180

gcccacgctg atatcgccaa gtgagggatc agaatagtgc atggggcacgt cgatgctgcc  
240

acattgagcg gaggcaatat ctacctgagg tgggcattct tcccagcgga tgttttcttg  
300

cgctgctgca gtgggcattg ataccaaaaa ggggctaagc gcagtcgagg cggcaagaac  
360

tgctactacc ttttttattg tcgaacgggg cattacggct ccaaggacgt ttgttttctg  
420

ggtcagttac cccaaaaagc atatacagag accaatgatt tttcattaaa aaggcaggga  
480

tttgttataa gtatgggtcg tattctgtgc gacgggtgta cctcggctag aatttctccc  
540

catgacacca g  
551

<210> 18

<211> 365

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(365)

<400> 18

gtg gcc gaa caa gtt aaa ttg agc gtg gag ttg ata gcg tgc agt tct  
48

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser

1 5 10 15

ttt act cca ccc gct gat gtt gag tgg tca act gat gtt gag ggc gcg



96  
Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala

20

25

30

gaa gca ctc gtc gag ttt gcg ggt cgt gcc tgc tac gaa act ttt gat  
144

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp

35

40

45

aag ccg aac cct cga act gct tcc aat gct gcg tat ctg cgc cac atc  
192

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile

50

55

60

atg gaa gtg ggg cac act gct ttg ctt gag cat gcc aat gcc acg atg  
240

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met

65

70

75

80

tat atc cga ggc att tct cgg tcc gcg acc cat gaa ttg gtc cga cac  
288

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His

85

90

95

cgc cat ttt tcc ttc tct caa ctg tct cag cgt ttc gtg cac agc gga  
336

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly

100

105

110

gaa tcg gaa gta gtg gtg ccc act ctc at  
365

Glu Ser Glu Val Val Val Pro Thr Leu Ile

115

120

<210> 19

<211> 122

<212> PRT

<213> Corynebacterium glutamicum

<400> 19

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser  
1 5 10 15

Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala  
20 25 30

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp  
35 40 45

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile  
50 55 60

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met  
65 70 75 80

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His  
85 90 95

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly  
100 105 110

Glu Ser Glu Val Val Val Pro Thr Leu Ile  
115 120

<210> 20

<211> 833

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(833)

<400> 20

atg gct aca gtt gaa aat ttc aat gaa ctt ccc gca cac gta tgg cca  
48

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro

1 5 10 15

cgc aat gca gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg  
96

Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val

20 25 30

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc  
144

Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val

35 40 45

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc  
192

Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe

50 55 60

ggt gga cca ggc aat gtg cac tac gca tcc aaa gcg ttc ctg acc aag  
240

Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys

65 70 75 80

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gcg  
288

Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala

85

90

95

tcc atc aat gaa ctg ggc att gcc ctg gcc gct ggt ttc ccg gcc agc  
336

Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser

100

105

110

cgt atc acc gcg cac ggc aac aac aaa ggc gta gag ttc ctg cgc gcg  
384

Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala

115

120

125

ttg gtt caa aac ggt gtc ggg cat gtg gtg ctg gac tcc gcg cag gaa  
432

Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu

130

135

140

ttg gaa ctg ctg gat tac gtt gcc gct ggt gaa ggc aag atc cag gac  
480

Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp

145

150

155

160

gtg ttg atc cgc gtg aag cca ggt atc gaa gcc cac acc cac gag ttc  
528

Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe

165

170

175

atc gcc act agc cac gaa gac cag aag ttc gga ttc tcc ctg gca tcc  
576

Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser

180

185

190

ggt tcc gca ttc gaa gca gcg aaa gca gcc aac aat gca gag aac ttg  
624

Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu

195

200

205

aac ctg gtt ggt ctg cac tgc cat gtt ggt tcc cag gtg ttc gac gcc  
672

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala

210

215

220

gaa ggc ttc aag ctg gca gca gag cgc gtg ttg ggc ctg tac tca cag  
720

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln

225

230

235

240

atc cac agc gaa cta ggt gtc gcc ctt cct gag ctg gac ctc ggt ggc  
768

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly

245

250

255

gga tac ggc atc gcc tac act gca gat gag gaa cca ctc aac gtc gca  
816

Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala

260

265

270

gaa gtc gcc tcc gac ct  
833

Glu Val Ala Ser Asp Leu

275

<210> 21

<211> 278

<212> PRT

<213> Corynebacterium glutamicum

<400> 21

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro  
1 5 10 15

Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val  
20 25 30

Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val  
35 40 45

Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe  
50 55 60

Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys  
65 70 75 80

Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala  
85 90 95

Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser  
100 105 110

Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala  
115 120 125

Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu  
130 135 140

Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp  
145 150 155 160

Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe

165

170

175

Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser  
180 185 190

Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu  
195 200 205

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala  
210 215 220

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln  
225 230 235 240

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly  
245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala  
260 265 270

Glu Val Ala Ser Asp Leu  
275

<210> 22

<211> 28

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 22

gggtacctcg cgaagtagca cctgtcac  
28

<210> 23

<211> 26

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 23

gcggatcccc catgcccct caaaga  
26

<210> 24

<211> 21

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 24

aacgggcggt gaagggcaac t  
21

<210> 25

<211> 21

<212> DNA

<213> Artificial



<220>

<223> Primer

<400> 25

tgaaagacag gggatatccag a  
21

<210> 26

<211> 24

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 26

ccatggtacc aagtgcgtgg cgag  
24

<210> 27

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 27

ccatggtacc acactgtttc cttgc  
25

<210> 28

<211> 36

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 28

ctgggttcgga cgagtggagc cgaccattcc gcgagg  
36

<210> 29

<211> 36

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 29

ctcgctcggg cgagggtcgga ggcaacttct gcgacg  
36

<210> 30

<211> 6

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 30

ggtacc

6

<210> 31

<211> 18

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 31

ggatcttcac ctagatcc

18

<210> 32

<211> 16

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 32

ccctgataaa tgcttc

16

<210> 33

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 33  
ccggagaaga tgtaacaatg gctac  
25

<210> 34

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 34  
cctcgactgc agacccctag acacc  
25

<210> 35

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 35

Met	Ala	Leu	Val	Val	Gln	Lys	Tyr	Gly	Gly	Ser	Ser	Leu	Glu	Ser	Ala
1				5					10					15	

Glu	Arg	Ile	Arg	Asn	Val	Ala	Glu	Arg	Ile	Val	Ala	Thr	Lys	Lys	Ala	20	25	30
Gly	Asn	Asp	Val	Val	Val	Val	Val	Ser	Ala	Met	Gly	Asp	Thr	Thr	Asp	35	40	45
Glu	Leu	Leu	Glu	Leu	Ala	Ala	Ala	Val	Asn	Pro	Val	Pro	Pro	Ala	Arg	50	55	60
Glu	Met	Asp	Met	Leu	Leu	Thr	Ala	Gly	Glu	Arg	Ile	Ser	Asn	Ala	Leu	65	70	75
Val	Ala	Met	Ala	Ile	Glu	Ser	Leu	Gly	Ala	Glu	Ala	Gln	Ser	Phe	Thr	85	90	95
Gly	Ser	Gln	Ala	Gly	Val	Leu	Thr	Thr	Glu	Arg	His	Gly	Asn	Ala	Arg	100	105	110
Ile	Val	Asp	Val	Thr	Pro	Gly	Arg	Val	Arg	Glu	Ala	Leu	Asp	Glu	Gly	115	120	125
Lys	Ile	Cys	Ile	Val	Ala	Gly	Phe	Gln	Gly	Val	Asn	Lys	Glu	Thr	Arg	130	135	140
Asp	Val	Thr	Thr	Leu	Gly	Arg	Gly	Gly	Ser	Asp	Thr	Thr	Ala	Val	Ala	145	150	155
Leu	Ala	Ala	Ala	Leu	Asn	Ala	Asp	Val	Cys	Glu	Ile	Tyr	Ser	Asp	Val	165	170	175
Asp	Gly	Val	Tyr	Thr	Ala	Asp	Pro	Arg	Ile	Val	Pro	Asn	Ala	Gln	Lys	180	185	190
Leu	Glu	Lys	Leu	Ser	Phe	Glu	Glu	Met	Leu	Glu	Leu	Ala	Ala	Val	Gly	195	200	205

Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn  
210 215 220

Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu  
225 230 235 240

Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr  
245 250 255

Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile  
260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp  
275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu  
290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ser Asp Gly Arg  
305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr  
325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala  
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu  
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg  
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala  
385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr

405

410

415

Ala Gly Thr Gly Arg  
420

&lt;210&gt; 36

&lt;211&gt; 421

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 36

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala  
1 5 10 15

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala  
20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp  
35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg  
50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu  
65 70 75 80

Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr  
85 90 95

Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg  
100 105 110

Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly  
115 120 125

Lys	Ile	Cys	Ile	Val	Ala	Gly	Phe	Gln	Gly	Val	Asn	Lys	Glu	Thr	Arg	130	135	140	
Asp	Val	Thr	Thr	Leu	Gly	Arg	Gly	Gly	Ser	Asp	Thr	Thr	Ala	Val	Ala	145	150	155	160
Leu	Ala	Ala	Ala	Leu	Asn	Ala	Asp	Val	Cys	Glu	Ile	Tyr	Ser	Asp	Val	165	170	175	
Asp	Gly	Val	Tyr	Thr	Ala	Asp	Pro	Arg	Ile	Val	Pro	Asn	Ala	Gln	Lys	180	185	190	
Leu	Glu	Lys	Leu	Ser	Phe	Glu	Glu	Met	Leu	Glu	Leu	Ala	Ala	Val	Gly	195	200	205	
Ser	Lys	Ile	Leu	Val	Leu	Arg	Ser	Val	Glu	Tyr	Ala	Arg	Ala	Phe	Asn	210	215	220	
Val	Pro	Leu	Arg	Val	Arg	Ser	Ser	Tyr	Ser	Asn	Asp	Pro	Gly	Thr	Leu	225	230	235	240
Ile	Ala	Gly	Ser	Met	Glu	Asp	Ile	Pro	Val	Glu	Glu	Ala	Val	Leu	Thr	245	250	255	
Gly	Val	Ala	Thr	Asp	Lys	Ser	Glu	Ala	Lys	Val	Thr	Val	Leu	Gly	Ile	260	265	270	
Ser	Asp	Lys	Pro	Gly	Glu	Ala	Ala	Lys	Val	Phe	Arg	Ala	Leu	Ala	Asp	275	280	285	
Ala	Glu	Ile	Asn	Ile	Asp	Met	Val	Leu	Gln	Asn	Val	Ser	Ser	Val	Glu	290	295	300	
Asp	Gly	Thr	Thr	Asp	Ile	Thr	Phe	Thr	Cys	Pro	Arg	Ala	Asp	Gly	Arg	305	310	315	320



Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr  
 325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Asp Lys Val Ser Leu Val Gly Ala  
 340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu  
 355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg  
 370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala  
 385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr  
 405 410 415

Ala Gly Thr Gly Arg  
 420

<210> 37

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 37

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala  
 1 5 10 15

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala  
 20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp  
 35 40 45  
 Glu Leu Leu Glu Leu Ala Ala Val Asn Pro Val Pro Pro Ala Arg  
 50 55 60  
 Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu  
 65 70 75 80  
 Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr  
 85 90 95  
 Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg  
 100 105 110  
 Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly  
 115 120 125  
 Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg  
 130 135 140  
 Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala  
 145 150 155 160  
 Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val  
 165 170 175  
 Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys  
 180 185 190  
 Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly  
 195 200 205  
 Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn  
 210 215 220  
 Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu

225		230		235		240
Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr						
		245		250		255
Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile						
		260		265		270
Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp						
		275		280		285
Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu						
		290		295		300
Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg						
305		310		315		320
Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr						
		325		330		335
Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala						
		340		345		350
Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu						
		355		360		365
Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg						
		370		375		380
Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala						
385		390		395		400
Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr						
		405		410		415
Ala Gly Thr Gly Arg						
		420				